

A discussion on compensation of forest ecological engineering benefit

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Abstract: On the basis of analysis of the present situation of the ecological benefit compensation in China and foreign countries, this paper discusses the necessity, principle and approach of establishing the compensation mechanism of forest ecological benefit, as well as compensation standard in order to provide scientific basis for further perfecting the compensation mechanism of forest ecological engineering benefit in China. It is suggested that setting up the compensation mechanism of forest ecological benefit can not only provide the steady funds source of managing and protecting forest resources, but resolve radically the dynamic and mechanism problems of commonweal forest ecological engineering construction, which will produce a widespread and profound influence on China forestry and ecological construction.

Key words: Ecological benefit; Ecological compensation; Compensation mechanism

Introduction

Forest as the main part of land ecological system is well known for its large ecological benefits such as soil and water conservation, preventing wind and controlling desertification, protecting water resource, improving environment and purifying atmosphere and so on. Some countries adjust their own strategy to improve forest management and protection and tree breeding and cultivation and regard forestry as the main target and the commonweal. Forest plays a very important role in the economic development pattern, and forest development has been identified as the first priority in supporting. In order to change the positions existed long-term in forestry that “the minority have burden for the forest, the majority can be benefit from forest; the poor districts have heavy shoulder, the rich districts only enjoy; the upper reaches invest, the lower reaches profit”, China has already stipulated definitely in “Forest Law” that “The state sets up the compensation mechanism of forest ecological benefit for the purpose of protecting forest resource and improving forest management and tree breeding and cultivation. The compensation fund of forest ecological benefit must be used for the special purpose but not others”. The prescript supplies China with legis-

lative gist for building perfect compensation system of forest ecological benefit, and thereby founds the new nationwide surroundings for forestry developing of “society governs forest by itself”. However, at present, the compensation mechanism of forest ecological benefit has not been systematic and perfect yet. It has particularly important and strategic meanings not only for the fragile ecological regions but also for the regions with rich forest resources, in the fields of improving forest ecological function radically, reducing and avoiding natural disasters, confirming the major position of ecological system of forest, maintaining ecological balance, and establishing perfect compensation mechanism of forest ecological benefit.

The meaning of ecological compensation mechanism

In recent years there has been an increasing focus on the ecological benefit compensation in public society and academe, but still a dispute on the meaning of the compensation mechanism (Lu 1994; Hou *et al.* 1995; Zhou *et al.* 1999; Li 2001). The first opinion is that the ecological benefit compensation is the collection fees for the purpose of controlling ecological destruction. The second opinion is that the ecological benefit compensation is the collection fees for controlling ecological destruction and restraining resource exhaustion. The collection range is various conducts that can cause direct effect on ecological environment but not included in the current pollution fees.” The relationship between the ecological benefit compensation and the compensation fees for resource exploitation can be confused easily, similarly as the relationship between the ecological benefit compensation and draining fees. The third opinion is that in China, the compensation fees for resource exploitation is equivalent to the ecological benefit compensation. At present, the definition of the ecological benefit compensation is divided into two sorts: broad sense and narrow sense is accepted by most people. The ecological benefit compensation in broad sense includes the two kinds of compensations for ecological destruction and ecological function, while the narrow sense especially points to the compensation for ecological function or ecological value. Concretely, the economic compensation involves two aspects that the units and individuals who cost a lot for the sake of protecting and re-

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suming ecological environment and function should obtain economic compensation, whereas those damaged the ecological function or caused the loss of ecological value should be collected fees.

The necessity for establishing the compensation mechanism of forest ecological benefit

Urgent need of production and practice

The reason compensating forest ecological benefit is that ecological benefit is the exterior economic benefit of forest, that is to say other economic subjects can not be benefited from market exchange. It is called public commodities in some foreign country, and there should be particular methods to calculate the value of the public commodities and to compensate them. The forest ecological compensation is a kind of value repayment to the forest ecological benefit, and is also an objective requirement of commodity economy law of value. The establishment of perfect forestry ecological system is considered as the primary goal of forest development strategy in China. However, the contradiction between ecological environment worsening and the insufficient forestry funds has been conspicuous day by day recently, thus the establishment of perfect compensation mechanism of forest ecological benefit is a urgent need for achieving great-leap-forward development forestry in China, which will bring our forest construction into a new stage.

Basic requirement of the country sustainable development

In the past years, forest resources reduced sharply and the environment deteriorated because of human being unreasonable exploiting activities and economic growth at the cost of environment deterioration. According to the statistics, approximate 17 million hm² of forest is felled every year all over the world, accompanied by the extinction of a hundred of species every day. The World Research Institute of Observation estimates that, each continent losses 24 billion tons soil every year. The environmental condition in China is troublesome too, such as the serious flood disasters and desertification. In 1993, the sandstorm occurred in north-western part of China caused direct economic loss of 0.5 billion yuan RMB. Thus the protection and construction of ecological environment have become the basic requirement of the country sustainable development. At present, the natural forest protection project, reducing cultivated land and afforestation are implementing but still need relevant mechanism to guarantee long-term consolidation of construction achievement. For this reason, the key of compensation mechanism of ecological benefit lies in powerful political support and steady funding source, and implementing long-term and steadily the state guidelines of ecological environment protection and construction.

The significant guarantee of building ecological commonweal forest

According to the demands of forestry classified management, the ecological commonweal forest is defined as the protection forest and the forest with special use, especially producing ecological benefit. Its establishment aims to fulfill the public service need of territory security and improving ecological environment, and

it is a public service that serves society and profits all people. The establishment of ecological compensation mechanism can supplement the inadequacy of state financial allocation and ensure sustainable development of constructing commonweal forest. Furthermore it will change the unreasonable condition of forest ecological benefit that enjoyed free for a long time and invested heavily in forest managers but no gain. For example, the funds that the developed regions in the middle and lower reaches of the Yangtze River supply to the destitute county at the middle and upper reaches, forest and industrial enterprise, state-owned forestry centre, natural reserves and other forest owners, are no longer in the simple form of supporting the poor or charity but a kind of division of labor and benefit complement each other.

Establishing the compensation mechanism is another necessary condition that can make some destitute regions with fragile ecology out of the vicious circle.

Destitute regions are mostly fragile ecology regions whose ecological environment requires to be governed urgently. At present, the phenomenon of district dislocation between district investments and district benefits exist commonly, thus ecological compensation policy is necessary for the regions. Firstly, since people in the destitute regions live with very heavy burden, it is difficult for them to improve ecological environment without outside support. In contrast, the district benefits in the developed districts are able to help the ecological restoration and reconstruction of district investment. Secondly, ecological environment of the fragile ecology regions has a public-thing-character, which is the base of the existence and development of both the districts investment and the district benefits. The ecological environment is closely correlated between districts, which are gradually recognized by people, and the fragile ecology regions are attached more and more importance. Therefore the establishment of ecological compensation mechanism will become another necessary condition for avoiding the vicious circle of ecological environment in some fragile ecology regions (Hong 2001)

The status of ecological benefit compensation in the world

The experience of forest ecological benefit compensation of the developed countries

As the forest resources are rich, many developed countries pay much attention to the effect of forest ecological benefit and attach great importance to the investment of ecological environment. The strategy of sustainable development of forestry in these countries is unitive between the government and market. Governments subsidize forestry and collect the compensation fees of ecological benefit to solve the issue of insufficient expenses on building and protecting forests. As a result, the forest coverage in developed countries keeps a high level, and ecological environment has being improved effectually. (Wang *et al.* 1998; Wu *et al.* 2001; Chen 2001)

The government invests in forestry

Forest ecological function is many-faceted and its benefiting object is omnibearing or society-wide. As far as the country concerned, the country support for forestry has been the largest

compensation to the forest ecological benefit.

America, Brazil and Costa Rica are three countries that have been implementing successfully the policy of ecological benefit compensation. Their experiences are in common that the government is the main purchaser of ecological benefit. American government chose some active measures to improve ecological benefit, for example, the government purchased ecological benefit and supplied the compensation funds. American state-owned forest and public-owned forest are approved and executed through the state bureau of forestry and the continent department of forestry budget firstly, then reported to the parliament of federation and states, and the amount of national investment is increasing continually. In England and France, the income of state-owned forest is not turned back to higher authority but is still used to forest development, and the inadequacy is supplied by the government allocation or preferential loan. Austrian forestry is high-invested, of which federation investment reaches five billion schilling every year. German state-owned forest implements the budget policy and appropriate funds are financed after examination and approval of the continent parliament. The investment of former Soviet Union countries accounted for 10% of state-owned management expenditure. Japan practices “Special Conference Law” towards forestry. The implementation of the law can effectively guarantee the investment in forest industry and the income of state-owned forest every year.

The government subsidized for non-state-owned forest

Austria pays close attention to reducing the cultivated land and afforestation. Furthermore, it combines investment and improvement of ecology closely. In order to create more forests with approximate natural condition, Austria discourages the small forest owners to produce woods except for forests with approximate natural condition. Towards private forest owner, English subsidizing standards are that conifer forest is 100 pounds-hm⁻², broadleaf forest 250 funds per hm² and fostering subsidy is 25 to 50 year, 3 pounds per hm² per year. The state forest fund is taken charge by French government, and it builds forestry funds through three ways, investing directly by benefit group, establishing tax special use and publishing debentures. “Encourage afforesting Law” formulated by New Zealand parliament stipulates the government equally subsidizes a half of the forestation expenses of small land owner, namely 600 yuan per hm². Finland provides low interest loan for forestland construction and also provides low product and finance subsidization for forest reformation.

Reducing forest assets tax

To reduce forest resource tax can compensate forest ecological benefit and increase forestry investment. French government stipulates that the land tax of private afforestation is exempted for the first five years, and wood income tax is reduced during 10 to 30 years separately according to the species of trees, moreover property transferring tax of forest assets can also be reduced 75%. In Finland, the income tax can be exempted if foresting is over 15 years, and state-owned forests need to pay a few taxes to the locality, but the tax is exempt if the forest area is less than 200 hm². In Germany, all expenses for managing forest and producing wood can be listed in the income tax of corporations, companies and families at the same year, and the state collects income tax only towards the income from subtracting expenditure of managing forest, but cooperative tree farms are tax-free. Japanese government takes care of the forest owners sufficiently on

tax, some tax are reduced, and some are exempted. Brazil builds afforestation renewing investment by reducing tax.

Collecting compensation fees from the department profiting directly from forest ecological benefit

In Canada, the tourism department such as forest park, botanical garden, hunting farm, nature reserve must compensate for the forestation departments using a few proportions of the income of entrance ticket. In addition, from the beginning of the 90s, some western member countries of OECD have formulated many measures to make tax system green one after another, in order to protect natural eco-environment and achieve sustainable development. European Union also carried out carbon dioxide tax among the member countries, and began to realize the ecological benefit compensation. Japan takes a series of actions to solve water lacking, such as introducing the forest function of protecting water resource, building water source forest funds, and compensating the forest owner at the upper reaches of the river by collecting fees, and this form has been operated successfully for more than a hundred years. America collects herding tax from the state-owned forest regions in western 11 continents, a part of which is used for the grazing lands’ renewing, protection and reformation. Colombia has been collecting fees from polluters and beneficiaries since the beginning of 1974. So far it has accumulated a lot of funds, and recently about 150 million dollars are transferred from electricity power department to the local environment organization, specially used for reforestation and river basin management.

Institutionalized and legitimated compensation of ecological benefit at abroad

The forest law of Japan stipulates definitely that state should compensate appropriately the secure forest owner and ensure that the benefits are not reduced. State also requests the groups and the individuals benefited to bear a part of total compensation fees. The forest law of the former Federal Republic of Germany stipulated that the forest owner had the right to require compensation under the following conditions: one’s forest was declared to become protection forest, prohibitory or touring forest, or in the scope of land maintenance and nature reserve management policy or restrictive measures are issued that are good for public, but not good for the forest owner. Swedish forest law also stipulates that if certain woodland is proclaimed to be nature reserve, all economic loss of the owner will be compensated abundantly by the state.

Practice testifies that compensation policy mentioned above supplies the fund sources for the establishment of ecological commonwealth forest, raises the enthusiasm of forest farmers, and promotes the development of ecological commonwealth forest. The compensation policy plays a very important role in improving ecological environment.

Situation in compensation of forest ecological benefit in China

In China, relative documents and compensation policies of forest ecological benefit have been issued in succession since late 1980s in the 20th century. The compensation policy of forest ecological benefit was formally put forward in 1989. In 1992, State Council of China ratified “the report on the main points of economic system reform in 1992”. The document pointed out the policy of forest price and the compensation of forest ecological benefit, and also included that “using forest resource should be

paid". In 1992, the report on the situation and relevant policy from UN conference on environment and development mentioned firstly the principle that resource utilization should be paid, compensation fees should be collected gradually, and the research on environment tax should also be initiated. In 1993, State Council pointed out in "The Notice on Going Step Together to Strengthen Afforestation" that funds must be reformed and that the policy for collecting the compensation of forest ecological benefit must be implemented step by step. On March 25th 1994, "Chinese 21st century population, environment and development white paper" passed by the mission on State Council the 16th standing conference required that the compensation policy of forest ecological benefit should be established and compensation fees for forest resource exploiting should be put into practice. In 1995, the thought on the compensation policy of forest ecological benefit was written into "total compendium of forestry economic mechanism reform". On January 21st 1996, the Central Committee of Communist Party of China and State Council definitely pointed out the principle that the compensation-fees policy of forest ecological benefit, the investment in construction mechanism of ecological commonweal forest should be established step by step, and recovery and development of forest plants should be accelerated. In 1997, the Ministry of Finance and former Department of Forestry, R. P. China, delivered to State Council the report of "The provisional way about the management of collecting the compensation funds of forest ecological benefit" and relevant harmonization conditions. On April 29th 1998, forest law amendment passed on the 9th Standing Committee of the National People's Congress Second conference stipulated clearly that state should establish the compensation funds of forest ecological benefit, and it must be used especially to build, foster, protect and manage protection forest. At January in 2001, Ministry of Finance agreed on establishing the compensation funds of forest ecological benefit. Through more than 10 years of hard work, Chinese special compensation funds of forest ecological benefit has already been brought into financial budget. This is a significant thing of the construction of forestry ecology, and a major measure of building ecological environment by our government (Wang *et al.* 1998; Zheng *et al.* 2001; Chen *et al.* 2001; Wu *et al.* 2001).

Since 2000, 30% forest in China has been brought into ecological commonweal forest, and corresponding compensation policy of forest ecological benefit was also established. In 2001, Ministry of Finance and National Bureau of Forestry identified 658 counties of 11 provinces and 24 State-level natural reserves as the experimental units of ecological benefit subsidy, thus the compensation policy of ecological benefit was carried out formally, which involved 13.333 million hm² key protection forest and forests of special use. Such local finance as Guangdong, Fujian, Zhejiang and so on, took out special funds to use as compensation of commonweal forest. So far, forestation fees of commonweal forest and management fees were listed in expense of Natural Forest Protection Project in 22 units of provincial level. In 24 provinces, 80% of state's expenditure paid for reforesting cultivated land was used to build commonweal forest, most of which have the character of forest compensation. Afforestation fees spent by the project of preventing and administering sand in five provinces subsidized ecological forest basically in seedlings. This indicated that Chinese government not only realized the significant value of the forest ecological function, but also stepped out the first step for ecological compensation of crossing region.

Some provinces in China that attached importance to eco-environment construction has being put forward relevant policy and stipulation, along with the gradual establishment and continuous development of socialism marketed economy system.

In 1994, Guangdong Province formally began to manage ecological commonweal forest and business forest classified in legislative form. In 1998, Guangdong established the compensation mechanisms for manager ecological commonweal forest. The forest protection and management rules of Guangdong stipulated definitely that all levels of government must arrange about 1% local finance expenditure per year for afforesting, forest fostering, forest protecting, ecological commonweal forest building and forestry science and technical training. In January 1999, "methods of Guangdong's ecological commonweal forest building and managing and benefit compensation" stipulated that the funds used building, protecting and managing ecological commonweal forest were no less than 30%. Commonweal forest felling was prohibited, and the economic loss of manager was compensated by local government. The provincial finance compensated 37.5 yuan per hectare every year, and the other parts were compensated by the cities and the counties. Liaoning Province implemented the collection fee policy of water source, which is concluded partly into the fund of construction funds of building water resources preventing forest, and water and soil preserving forest, after province National People's Congress legislative procedure and was issued by the official document. Started from 1988, the industrial enterprise of mining and papermaking, the purchasing enterprise of crude drugs and silkworm cocoon, as well as business unit offices, organizations, armies and collectives were demanded to deliver construction fund to build water source holding forest and water and soiling preserving forest. Xinjiang Province also begins to collect compensation fees all around the region, and the decision on accelerating reform and development of forestry stipulates that the scope and standards of compensation fund of forest ecological benefit are the staff of offices, organizations and business units and are collected proportionally according to their ways, department of petroleum and mine were collected according to their output. The collection fees charged in the forestry departments were arranged to build and maintain ecological commonweal forest and protect wild plants. In Guangxi Province, one million yuan was used to establish water resource preventing forest and water and soil preserving forest. Yao County in Shanxi Province stipulated that departments of water conservancy and water protection handed over 10% of the water resource fee to forestry department every year for building water source preventing forest. Both Linhe of Inner Mongolia and Chang Chun of Jilin Province collect 7.5 to 15 yuan per hectare per year ecological compensation fee, which was used for farmland protection forest's fostering and managing, together with renewing and transforming. Chengde area in Hebei Province was the water resource forest region of Beijing and Tianjin, it offers 96.4% of water resource to the project of leading water into Tianjin, and 56% of water resource to Miyun reservoir. By consulting spontaneously, Beijing compensated Fengning County one million yuan from the finance and Tianjin 0.4 million yuan every year. In Sichuan Province, the city government had decided to hand over 25% ticket income of Qingcheng mountain scenic spot's to protect forest and prevent fire since the middle of 1980s. From 1998 to the end of November 1991, the forestry department have had 0.5 million yuan from ticket income. (Chen *et al.* 2000; Zheng *et al.* 2001; Chen *et al.* 2001; Wu *et al.* 2001)

At present, the building job of forest ecological compensation is steadily moving forward in China. Some ecological compensation policies and ways are playing directly or indirectly the very important role in protecting natural forest and reforesting cultivated land. The practice provides experience for perfecting and building further ecological compensation mechanism and promotes sustainable development. The compensation fund of forest ecological benefit, supplies not only steady fund source for managing forest resources, but also the acknowledgement for forest ecological benefit value. It solves the problem of the power and mechanism of ecological commonweal forest construction basically, and products profound influence to Chinese forestry and ecological establishment.

Apparently, it is a long-term process to establish the perfect compensation mechanism of ecological benefit, and some problems wait for the thorough research such as the compensation principle, compensation standard, compensation scope of forest ecological benefit, collection object and compensating method, and the management compensation fund of forest ecological benefit. Because of the imperfect mechanism, compensation can not completely depend on the principle and law. It is noted that serious administrative character usually leads to the compensation not be done perfectly. For this reason, China needs to establish perfect and unified compensation mechanism of forest ecological benefit.

The principles and methods for establishing the compensation mechanism of forest ecological benefit

The compensation principle of forest ecological benefit

According to the principle of equal value exchange, the total principle for the compensation of forest ecological benefit should be “the people who invest get the profit” and “takes from society, serves for society”.

The principle that government helps mainly

In the past years, Chinese forestry exchanged a great development by sacrificing the felling of natural forest, the finite allowance arranged in the budget of the nation, as well as the labor of vast farmers and the struggle of forestry workers. It is difficult for the local government to invest a lot of money in the forest ecological project. As the organizer and the director of the ecological environment construction and the sustainable development, state should undertake the main responsibility and the main fund of construction. According to status of the forest ecological project, the compensation funds of forest ecological benefit should be supported mainly by state. The investment in forest confirmed to be commonweal forest is increasing continuously all around the world.

The principle of macroscopic control and positive circulation

It is noted that the implementations of forest protecting and felling forbidding may impact directly or indirectly the local forest staff's income and the local economic development, especially in the building region of protecting and enlarging natural forest resource. Thus state should take some positive actions to develop the local economy, promote the positive circulation of the region economy, build and protect local ecological environment. The macroscopic control and economic slant are great necessary for the building regions of forest ecological project. Ecological

compensation is a macroscopic concept and need people participate nationwide, including not only eastern, middle and western region, but also the drainage area in the province, as well as the compensation of some areas themselves. Using fund can be moderately inclined toward the important region such as western regions, which are good for the corporate development of protected regions and profited regions.

The principle of benefiting directly and compensating legally

Scientific researches testify that the total ecological value of forestry is several times or even several dozen of the wood's value. Taking the forest's function of holding water as example, it is estimated that forest ecological systems can hold water about 123 billion ton per year in China, and its environmental value reaches 7.5 thousand billion yuan RMB, in contrast, the whole wood's value of forest is just 2.5 thousand billion. Wood need is the main reason that causes destroy of forest ecological system. Therefore, in order to protect forest, the forest owner must gain the same income from producing wood as under normal condition (Wen 1999; Hong 2000; Zheng *et al.* 2001; Chen *et al.* 2001). According to the market economical principle that “the one who benefits shoulder”, the forest ecological benefit can be divided into a few items, implemented separately as follows:

Forest stores water, conserves soil, prevents silt and prolongs the using life of reservoirs and dams. The main beneficiaries are departments of water and electricity.

Forest supplies steady and high quality water resources, reduces flood and drought and ensures farming. The beneficiaries are departments of agriculture.

Forest retards silting of rivers and lakes and guarantees steady water quantity of rivers, which visitors can enjoy the pretty scenery. The beneficiaries are departments of water transport and travel.

Forest offers clean and fresh water, and the beneficiaries are residents in cities and industrial enterprises.

Forest protects bio-diversity and maintains the ecological balance on the public lands. The beneficiaries are the whole society.

Forest ecological benefit, a special commodity, can not realize its compensation value only through market exchange. Government legislation and collection fees may be the only effective way. The departments, industrial enterprises or individuals benefited directly are farced to pay compensation fees for forest ecological benefit through formulating relative policies and laws. Collection fees are administered by local finance and must be used to establish compensation funds of forest ecological benefit.

The principle of different-class compensation and projecting emphasis

The use and distribution of forest ecological benefit compensation fees should be handled distinctively with forestry ecological project construction. Compensation grades can be classified by the importance of project regions. For example, the vital project regions need the key support and compensation can be also inclined to these regions. Protection of natural forest is the core in the compensation of forest ecological benefit, thus its compensation standard should be at the highest level.

The methods for establishing compensation mechanism of forest ecological benefit.

On the basis of experiences and ways at home and abroad, the compensation fund sources of forest ecological benefit mainly

depend on the state finance support such as investment, subsidy and reducing taxes. Finance supporting funds can be collected from relative governmental funds income and social public governmental tax by establishing compensation fund of forest ecological benefit, and the compensation fund of official regions and departmental industries etc. can be collected from local finance, department and industries income, (Wang *et al.* 1995; Chen *et al.* 1999; Zhou *et al.* 1999; Huang *et al.* 2000; Xu *et al.* 2000; Hong *et al.* 2001; Wen *et al.* 2001; Zheng *et al.* 2001; Wu *et al.* 2001)

Gratis support of state finance

The finance supporting funds firstly originate the special subsidy of state finance, followed by the funds of state undertaking fees, and investment of state planning committee capital construction, According to management way of annual planning project, it fulfill on concrete projects of ecological forest construction, which contain protecting and building projects of various ecological environment, the developing projects of ecological key protecting regions substitute industry and substitutive energy, as well as support of immigrant project for ecology.

The compensation fund of forest ecological benefit.

Ecological benefit and social benefit have the character of public product, thus the relative economic bodies have the responsibility to make some economic compensation for enjoying forestry benefit. The compensation fund of forest ecological benefit can be raised by following methods: (1) financial subsidies; (2) tax addition. Tax is substantially one important way that state participates the assignment of national income. The substance of compensation tax addition of forest ecological benefit in distribution is that the state can collect environmental cost from units or individual of social product (or consumption) profited from the improvement of ecological environment. The collection fees are returned to improve ecological environment and offer better service to society. The fund circulation reflects the principle that the whole society profits from forest ecological benefit and the whole society burdens it.

The building fees of forest ecological benefit is undertaken by beneficiaries

According to the principle of "the people who profit compensate, the collection of compensation fees involve the following methods: (1) compensation fees collected from beneficiaries mainly include the collection fees of water and electricity. For example, some provinces, such as Guangdong, Liaoning, Sichuan, Hunan, Xinjiang, Anhui, have all formulated the region policy. The compensation fees of commonweal forest ecological benefit are collected to a certain amount from enterprises of water conservancy, but the collection fees are returned to build water source protecting forest. Moreover, collection fees from traveling income, special funds are used to make up deficiency upper reaches of scenic spot's management and protecting funds of forest resources. (2) Investment in ecological forest is mainly undertaken by beneficiaries. For example, the green passage way project was implemented in 1998 in Shanxi. The province, prefecture and county undertook 60%, 20%, 20% of investment respectively. Investment of province-level was undertaken 40% by transportation department and 20% by forestry department.

Issuing national debt

Issuing national debt is an important way of collecting funds. Theoretically, the period of forestry production is long and the

construction of ecological forest is good for successors. Therefore, it is reasonable that parts of fees are undertaken by successors. With the development of social economy, people's income will increase to a high level, and the demand for better ecological environment also increase, then people are satisfied and the state has ability to repay debt.

International contribution

Another important fund sources are the contributions and supports of international organizations, foreign governments, units and individuals, as well as internal units and individuals. The developing fund of Chinese agenda in 21st century-forestry action planning is well-established to aid the significant and sustainable developing action at home and abroad, such as eliminating poverty, preventing and curing desertification, establishing protecting forest system and administering environment pollution. Typically, Japan helps to improve the ecological environment of northeastern and northern China. At present, some international organizations, for instance, GEF and WWF has being provided us money for the special purpose of protect Chinese forest resources. In addition, collection funds from social attribution have being done by the way of establishing ecological lottery ticket.

Collecting people obligatory planting trees fee

A decision on developing people tree planting obligation was made on the 5th National People's Congress forth conference. The decision stipulates that every citizen have the obligation to participate in the activities of planting trees. If someone does not participate in the activity for some reasons, the labor fees should be collected to substitute tree plants.

Starting to collect ecological tax

In recent years, western countries have being started to collect ecological tax. Some countries establish a perfect system of ecological tax, which may is a very important direction for traditional tax innovation. Moreover, some Asia countries (Singapore, India and Korea) and eastern European countries such as Poland and Hungary adopt ecological tax policies. Collection of ecological tax is benefit for solving the double relations between material compensation and value compensation of ecological resource, and using financial means and its derivative instruments to eliminate market outer non-economy phenomenon existing on the problem of ecological environment. The "outer cost" is embodied in price, and then makes the sustainable development and ecological environment protection into a policy arrangement with inner commercial value, and guarantee the sustainable development of natural resource and ecological environment.

There are some other methods to compensate indirectly forest ecological benefit, such as ecological financing and the preferential loan from the international financial organizations such as global bank and Asia bank. The government can invest these international loan into the item of western ecological construction, and the center finance supports western ecological establishment item with loan subsidizing interest, allowing forest to pledge loan and prolonging the period of reforesting cultivated land subsidy, enlarging the extent of ecology immigrant and poor immigrant and supporting item of exploiting western water and electricity resources, and so on.

The compensation standard of forest ecological benefit

Compensation standard is the key problem of compensation mechanism of forest ecological benefit, which directly impacts on the compensation effect and bearing capacity of compensator. However, due to the invisible and multi-effect of forest ecological benefit, it is still difficult to calculate accurately the compensation of forest ecological benefit.

At present, the compensation policies of commonweal forest well-established mainly include Marxian labor value theory regarding the forest as social public commodity (Kong *et al.* 1994; Zhang 1999), ecological value theory taking the currency as the scale of calculating forest ecological benefit quantitatively (Zhang 1999; Wen *et al.* 2001), Coase theorem program, through the negotiation, the beneficiaries of forest resources reach the agreement to compensate for forest resources. (Nie 2001; Song *et al.* 2001), and Pigou tax, solving the outer problems of forest resource through economic means or compensation and collection tax (Zheng *et al.* 2001; Chen *et al.* 2001; Wu *et al.* 2001). Some experts indicate “three aspects value” in practice: (1) inherent natural resource value; (2) inherent ecological environment value, it means natural elements functionality value towards ecological system; (3) the value produced by investment of people’s labor. The appraisalment of forest ecological benefit is the base of forest ecologist benefit compensation, and is also the key point for research of forest ecological benefit. The present research on the compensation mechanism of forest ecological benefit at home and abroad mainly focus on the connotation of ecological system service function as well as the methods and theories of estimating ecological benefit value (Hou *et al.* 1995; Zhou *et al.* 1999; Robert 1999; Zhao *et al.* 2000). Recently, the methods of estimating forest ecological benefit can be divided into four types: cost method, will-pay method, market-instituting method and energy-analysis method (Hou 1996; Su *et al.* 2000; Zheng *et al.* 2001; Chen *et al.* 2001; Wu *et al.* 2001). The size of forest ecological benefit value is dependent upon the supply and demand of forest ecological production and public will and burden capacity. Starting from the practical need, calculation and compensation of forest ecological benefit value should follow the principle of gradual implement and classified direction. From the calculation, the size of ecological value should be calculated according to the forest leading benefit, but the total benefit value need not be calculated comprehensively and accurately. From the compensation, part compensation should approach to whole compensation step by step.

At present, the Chinese compensation standard of forest ecological benefit is sole, and if the compensation standard want to meet the real situation, competition mechanism must be brought. Some scholars think that the compensation standard should be determined on the basis of the amount of ecological improvement, while others believe that, it is difficult to define the amount of ecological improvement. Thus the compensation standard should be determined according to social, economic and environmental condition everywhere. Prof. Wen Zoumin pointed out there was great difference in natural ecological condition between Northern and Southern China, and the charge in Southern China for protecting ecology was higher than that in Northern China. In the light of ecological quality, the compensation of forest ecological benefit is dependent on forest ecological quality

in a large extent. Therefore, we should pay more attention to the quality of ecology establishment

Under the situation that the compensation fund of our commonweal forest ecological benefit is insufficient, the compensation fund of forest ecological benefit should be utilized reasonably in two aspects: one is that the limited fund is invested into the key regions, especially fragile ecological regions, and the compensation standard is determined by the quality of ecological establishment; the other is building one or two forest ecological establishment demonstrating regions in every province.

Suggestion on establishing and perfecting the compensation mechanism of forest ecological benefit

In China, the theory research on compensation mechanism of forest ecological benefit seriously lags behind forestry produce practice and is far from satisfying the demand of forestry development. Fortunately, the conditions establishing the compensation mechanism is gradually becoming mature in China, and it provides a very important base for further research. Most of researches mainly focus on a certain aspect of the theory and method, but systematic research in practice is very few. The compensation mechanism of state ecological benefit should be built on the basis of legalization. First of all, ecological protection legislation needs to further strengthen, and it is the essential guarantee to build and consummate the compensation mechanism of ecological protection. In order to guarantee long-term and steady finance support to ecological environment protection in poor regions, definite stipulation of law is necessary. Secondly, special law on natural ecology protection should be made to stipulate and guideline the relate policies and measures of natural resource exploiting and governing, ecological environment protection and construction, as well as ecological environment investment and compensation. Thirdly, it is necessary to establish uniform collecting, managing policy and standard for ecological environment tax, which is defined by legislation.

The compensation mechanism of ecological benefit should be multi-stratification. Firstly, in countrywide, it is an obligation for developed region to enlarge support of fund and technology to middle and western regions with important ecological function. Secondly, lower reaches of ecological protection positively compensate the upper reaches, which the compensation can be across province, city or county. Thirdly, the compensation among different industries, ecological elements and exploited units of natural resources is also necessary. It is suggested that the state should enlarge the investment in western regions, especially the regions of national minority, using the forms of “finance transferring payment”, and ‘project support’. Moreover, the policy of industrial aid should be made as soon as possible, and then implemented step-by-step in the key area of environment construction according to the plan.

The accounting system of forest resource should be guided by ecological forestry theories and form scientific compensation standard. Traditional accounting system of forest resource under the direction of the principle of wood utilization should be reformed and changed according to the actual forest economy benefit. More potential value and function of forest resource should be brought into the accounting system.

In summary, the researches on compensation mechanism of Chinese forest ecological benefit are waiting for further investment and strengthen, and the key should be focused on compen-

sation object, scope, standard and collection object. Due to the non-exclusion characters of forest ecological benefit, it is difficult to define the property right boundary and effectiveness boundary, and the benefit and collect object is becoming the new difficult point for the further research. Another important key is to establish perfect supervision system and appraisalment system, which it is the guarantee for evaluating quantified benefits of ecological environment.

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